

AN ANALYSIS OF THE RELATIONSHIP  
BETWEEN STATE-TRAIT ANXIETY  
AND STUDENT NAVAL AVIATOR PERFORMANCE

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# NAVAL POSTGRADUATE SCHOOL

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# THESIS

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An Analysis of the Relationship  
between  
State-Trait Anxiety and Student Naval Aviator Performance

by

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## ABSTRACT

To properly select individuals for flight training using anxiety as a predictor, it was necessary to investigate various aspects of anxiety. Initially, anxiety must be defined and its relationship to learning and task performance revealed. Additionally the effects of an instructor pilot known as a "screamer" were analyzed. Empirical data was drawn from flight students at Patrol Squadron Thirty-One using the State-Trait Anxiety Inventory and a Supplementary Questionnaire. Although no statistically significant correlations between state and trait anxiety and flight grades were revealed, the correlations were all negative as face validity would indicate. Additionally, of thirty-three students, all indicated the "screamer" as a detriment to learning and task performance to various degrees.





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## I. INTRODUCTION

"Flight instructors and others who are responsible for the training of Naval Aviators should be familiar with the basic principles of learning and human behavior. A proof of any flight training course is the manner in which the graduate handles stressful situations in flight. Emergency procedures must become second nature to a pilot. The goal of all such training programs in the Navy should be the production of pilots who may be called upon time and again to test the limits of their capabilities and those of their aircraft in order to professionally carry out fleet commitments and to return safely to fly another day."<sup>1</sup>

The ability of the student pilot to learn the basic skills of piloting an aircraft and the ability to demonstrate this newly acquired proficiency is dependent on various psychological, physiological, and mechanical traits. In the selection of personnel for this profession, the utmost effort should be exerted in searching for reliable predictors of this demanding vocation.

To examine the relationship of anxiety to the student Naval Aviator is just such a task. The inherent problem is to determine whether there is any significant association between anxiety and student performance. Subsequently, the problem is to identify individuals accurately and handle them in accordance with the aforementioned relationships.

It is commonly accepted, and face validity indicates, that a highly anxious individual might not be the ideal candidate for the demanding

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<sup>1</sup> Alkov, R. A., "Flight Training and Human Factors", Approach, p. 33, November, 1967.



and stressful occupation of an aviator. If this relationship could be empirically supported by accurately identifying these individuals thousands of dollars could be saved which are now spent on the initial phases of flight training only to see the student DOR (drop on request) or fail to achieve qualifying flight grades.

It is equally important to ensure if this relationship is valid that those of moderate and upper levels of anxiety be given the opportunity to demonstrate their ability under favorable conditions. The new student aviator, thrust into a new environment with a new means of traversing it, needs varying techniques of instruction. Unfortunately this instruction does not usually change with the wide psychological diversity of students but rather remains relatively constant in accordance with the instructor pilot's personality and instruction technique.

Anxiety testing pre-flight students, classifying them according to anxiety levels, and subsequently flying them with instructors sensitive to students' emotional states would be a most desirable and productive training procedure.

Initially it must be shown that there exists some correlation between anxiety and the ability to learn and demonstrate flying skills. It is hypothesized that in the complex and stressful task of piloting an aircraft, a student pilot possessing a high level of anxiety will not perform as well as the student pilot experiencing low anxiety. One measure of how well a flight student performs is indicated by the grades received on each flight throughout his training. To be able to predict these flight



grades by measuring anxiety levels in student pilots would add significantly to the current aviator selection system.

An additional hypothesis purports that in the company of a flight instructor who is harsh and impatient (a "screamer"), the high anxiety student will feel that his performance will be consistently inferior as compared to his demonstrated expertise when flying with a patient instructor. Ideally, the best methodology to analyze this statement would be to note the flight grades received when the student flies with a "screamer" and compare those with similar hops flown with non-screamers.

To properly research how anxiety might affect the performance of a student pilot, it was first necessary to examine the basic theories of learning. Anxiety and its relationship to performance was then investigated and specifically defined for use in this thesis. Additional research was conducted relating the level and significance of anxiety to feedback or reinforcement. A brief review of past and present psychological testing for aviator selection is then presented. The remaining sections contain the methods and procedures used to gather empirical data, the presentation of this data, and the results and conclusions.



## II. ANXIETY AND LEARNING

### A. THEORIES OF LEARNING

The first hypothesis presented implies that anxiety will affect the ability of the pilot to learn and subsequently demonstrate his aviation skills. To understand how this might occur, it was first necessary to examine the basic theories of learning.

Although there are many definitions and conjectures describing the process of learning, "there has always been general agreement among authorities on the subject that learning refers to a more or less permanent change in behavior which occurs as a result of practice".<sup>2</sup> Various theories modify and expand this definition but the best known and most widely accepted are those of Clark L. Hull and Dollard and Miller.

Hull surmised that learning was the strengthening of associations between various stimuli and responses. Dollard and Miller, less than a decade later (1950), supported the beliefs of Hull when they theorized that the learning process evolved from drive reduction. Four events needed to occur before learning could result (or the drive reduced): drive, cue, response, and reinforcement. Initially the individual must have drive or the motivation to satisfy a specific need. Cues then provide the stimulus to direct the individual to action consequently reducing the drive.

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<sup>2</sup>Hilgard, E. R. and Marquis, D. G., Conditioning and Learning, p. 2, Appleton-Century-Grofts Inc., 1961





The response is the resultant action or behavior and reinforcement is the actual reduction of the drive itself. Learning theoretically occurs when the last step is completed.

"Learning theory, in part supported by empirical evidence, suggests that knowledge of results following termination of performance is necessary for subsequent modification of the learning process and for future facilitation of appropriate task performance."<sup>3</sup>

For a student pilot, the drive usually consists of the motivation to satisfy ego, achievement, and affiliation needs. The glory and thrill of flying, the recognition due a skilled aircraft pilot, the extra money involved (flight pay), and variations of these specific benefits, are almost always emphatically strong goals of the student pilots thus eliciting powerful responses and requiring liberal reinforcement.<sup>4</sup> The cues provide direction for the student pilot to fulfill all standards required of student pilots and this directed response hopefully results in reinforcement consisting of designation as a Naval Aviator. This overall learning process is also applied to a student for an individual flight. The steps then consist of the need to satisfactorily perform the requirements of the flight and the need to be regarded as a good pilot, the individual mental and physical preparation for the flight, the appropriate performance on

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<sup>3</sup>Fremont, T., Means, G., and Means, R., "Anxiety as a Function of Task Performance Feedback and Extraversion-Introversion", Psychological Reports, v. 27, p. 455, 1970.

<sup>4</sup>This list by no means purports to include all motivation for flying but was rather a sampling compiled by informal interviews with pilots of varied experience levels.



the hop itself, and the subsequent successful completion of the flight. The degree of learning thus varies directly with the motivation or drive level. This oversimplification assumes other variables to be negligible. "Laboratory investigations of classical conditioning, human maze learning, and serial and paired-associate verbal learning have provided empirical findings generally consistent with predictions from Drive Theory."<sup>5</sup>

B. F. Skinner emphasized that reinforcement of the response was the most important step in learning. If reinforcement were not provided, extinction of the learned behavior would occur. Extinction refers to a procedure in which a behavior which had been reinforced is no longer reinforced. Consequently, the behavior decreases in frequency. Additionally, if these reinforcements could be positive, the result would be successful shaping of the desired behavior.

The distinction between learning and performance is extremely important and the terms should not be used interchangeably.

"Learning refers to long-term changes of the organism produced by practice. Performance, on the other hand, refers to just this translation of learning into behavior. The level of performance depends upon relatively short-term factors such as motivation, the existence of appropriate environmental circumstances, and fatigue."<sup>6</sup>

Thus the performance of a flight student might not be indicative of how much he has learned and could be drastically altered by his immediate

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<sup>5</sup> Spielberger, C. D., "Complex Learning and Academic Achievement", In: Spielberger, C. D., Anxiety and Behavior, p. 365, Academic Press, 1966.

<sup>6</sup> Hilgard and Marquis, op. cit., p. 5.



surrounding. These factors may therefore not only hamper the initial learning of the task, but even reduce the subsequent performance designed to demonstrate what learning he had previously acquired. One of these emotional factors which could modify the task performance is the level of anxiety experienced by the flight students.

## B. ANXIETY. WHAT IS IT?

"Anxiety seems to be the dominant fact and is threatening to become the dominant cliché - of modern life. It shouts in the headlines, laughs nervously at cocktail parties, nags from advertisements, speaks suavely in the board room, whines from the stage, clatters from the Wall Street ticker, jokes with fake youthfulness on the golf course, and whispers in privacy each day before the shaving mirror and the dressing table. Not merely the black statistics of murder, suicide, alcoholism, and divorce betray anxiety (or that special form of anxiety which is guilt), but almost any innocent, everyday act: the limp or overhearty handshake, the second pack of cigarettes, or the third martini, the forgotten appointment, the stammer in mid-sentence, the wasted hour before the TV set, the spanked child, the new car unpaid for."<sup>7</sup>

From this description of anxiety, it would seem that anxiety is the common malady for all undesirable personality traits, the underlying cause of all bad habits, and the hidden justification for all crime. It does, however, indicate just how diverse is the accepted definition of anxiety. Possibly the tendency to attribute so much to anxiety ensues from the fact that research on the subject is relatively new. Since Freud first published his concepts of anxiety in 1894, much

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<sup>7</sup> Spielberger, C. D., "Theory and Research on Anxiety", In: Spielberger, C. D., Anxiety and Behavior, p. 3, Academic Press, 1966



has been accomplished in the way of clinical studies and research.

However the major portion of these investigations have occurred only in the last two decades. Indeed, anxiety was not even listed in the indexes of psychological books written before the late 1930's. In fact, during the period 1960 until 1963, the number of anxiety studies reported in Psychological Abstracts was ten times what it had been in 1930.<sup>8</sup> As

Raymond Cattell succinctly described the situation:

"Considering the morass of complete terminological and conceptual confusion in which the discussion of anxiety has wallowed in for 50 years, an experimenter may be forgiven some rejoicing in the sheer advance in definition, made operationally in factor analysis in the last decade."<sup>9</sup>

So what is this new and elusive field of study? The dictionary defines anxiety as "distress or uneasiness of mind caused by apprehension of danger or misfortune".<sup>10</sup> Other definitions state that the cause of this low-grade fear is unknown, and Freud believed that this unknown source was a result of the discharge of repressed, unrelieved somatic sexual tensions."<sup>11</sup> He conceived anxiety as a signal indicating the presence of a dangerous situation and classified anxiety into two basic types. Based on whether the source of this danger was from an internal source

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<sup>8</sup> Ibid., p. 5.

<sup>9</sup> Cattell, R. B., "Anxiety and Motivation, Theory and Experiments", In: Spielberger, C. D., Anxiety and Behavior, p. 24, Academic Press, 1966.

<sup>10</sup> Random House Unabridged Dictionary, 1970

<sup>11</sup> Freud, S., The Problem of Anxiety, p. 85, Norton, 1933.





or from the external world, anxiety was either neurotic or objective. Objective anxiety involved a complex internal reaction to anticipated injury or harm from an external danger. Neurotic anxiety was evoked from a danger that was internally initiated and could be traced to childhood. It was this latter type that Freud attributed to be the major cause of neurosis.

It is important to note that anxiety is not just fear but the apprehension of fear. May defines anxiety as:

"a diffuse apprehension, and that the central difference between fear and anxiety is that fear is a reaction to a specific danger while anxiety is unspecific, vague, objectless. The special characteristics of anxiety are the feelings of uncertainty and helplessness in the face of danger".<sup>12</sup>

Anxiety is further defined by May as:

"the apprehension cued off by a threat to some value the individual holds essential to his existence as a personality. The threat may be to physical or psychological life (death, or loss of freedom) or it may be to some other value which the individual identifies with his existence (patriotism the love of another person, success, etc.)"<sup>12</sup>

Further clarifying the difference between fear and anxiety, R. S. Grinker states:

"Man attempts to deal with anxiety, at least at first, by attributing it to some external source. He likes to call it fear and signifies some object that he is afraid of, hanging the reason for his anxiety on an external hook. There is constant confusion between the terms fear and anxiety, because man attempts to attribute his anxiety to external sources of which he says he is

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<sup>12</sup> U. S. Naval School of Aviation Medicine Report No. 55-13, Anxiety and Flying: 1. An Introduction to the Problem, by J. T. Bair and W. F. O'Connor, p. 1, 23 August, 1955.



afraid, and when he is afraid it is because the external objects have some particular personal meaning to him, with some exceptions. In extremely stressful situation, all of us become frightened and anxious."<sup>13</sup>

One additional concept of anxiety, theorized by Cattell and Scheier, is examined and defined after analyzing the effects of anxiety on learning and performance.

### C. THE EFFECTS OF ANXIETY ON LEARNING AND PERFORMANCE

With the basic understanding of learning theory and of the concept of anxiety, an analysis of the relationship between them commenced.

There are currently several theories relevant to the association of anxiety and task performance. The Mandler-Sarason viewpoint maintains:

"that anxiety arouses task-relevant or task-irrelevant responses. Supporting this view is evidence that perception of failure results in performance decrement for high anxious subjects (presumably by activating task-irrelevant responses), whereas perception of success results in superior performance for high anxious subjects (Presumably by activating task-relevant responses)".<sup>14</sup>

This viewpoint partially lends support to drive theory where reinforcement is so extremely vital to learning, but seems to neglect the drive or motivation required for task performance.

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<sup>13</sup> Grinker, R. R., "The Psychosomatic Aspects of Anxiety" In: Spielberger, C. D., Anxiety and Behavior, p. 133, Academic Press, 1966.

<sup>14</sup> Boor, M., and Harmon, J., "Comment on Weiner's (1966) Study: Role of Success and Failure in the Learning of Easy and Complex Task", Journal of Personality and Social Psychology, v. 16 p. 256. 1971.



Spence and Spence have offered a two-fold theory on learning and anxiety as measured by the Taylor Manifest Anxiety Scale (TMAS).<sup>15</sup> For simple classical conditioning where a single response is elicited from a single stimulus, the level of anxiety influences emotional response or drive D and thereby performance. Hull conceptualized that the learning factor (H) combines multiplicatively with a drive factor (D) to determine excitatory potential (E). This excitatory potential determines the strength of a given response. Thus with a single response and a heightened drive factor, it was theorized and empirically supported that a high anxiety group would be clearly superior to a low anxiety group.

However with complex learning tasks, the individual confronts a "series of stimulus items, each of which may evoke a number of competing responses with varying habit (H) strengths".<sup>16</sup> Using the same multiplicative relationship between H and D in determining E, the higher the level of D, the greater the difference the E values are for the correct and incorrect competing responses. Consequently,

"if the correct to-be-learned response is instead initially weaker than one or more of the competing response tendencies, then the

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<sup>15</sup> It is useful to note that although the majority of the work done with the TMAS have utilized the scale as an index of the personality variable, anxiety, the TMAS was, in fact, devised to measure emotional responsiveness and therefore drive level.

<sup>16</sup> Spence, J. T. and Spence, K. W., "The Motivational Components of Manifest Anxiety: Drive and Drive Stimuli", In: Spielberger, C. D., Anxiety and Behavior, p. 299, Academic Press, 1966.



higher the drive level, the poorer will be the performance during the early stages of learning. However, as learning of the correct responses increases over trials, the habit strength of these responses would be expected to equal and then exceed those of competing responses. Thus while the performance of a high drive group would be expected to be inferior to that of a low drive group in early stages of training, it should become superior in later stages."<sup>17</sup>

A flight student with a high drive level (or emotional response level as measured by an anxiety scale) might not do as well initially in training but eventually could surpass the piloting expertise of those individuals with lower drive. This is an especially relevant factor in flight training as almost one-half of the total number of flight failures attrite prior to the initial solo flight. This flight occurs after only twelve pre-solo instructional flights where the amount of learning the student must digest is considerable.<sup>18</sup>

One of the most interesting experiments examining high anxiety and task performance was conducted by an English psychologist, P. L. Broadhurst. He studied the interaction of anxiety and task performance by training rats to swim through an underwater maze constructed in the shape of the letter "Y". While underwater, the rat would go to the fork in the maze and be forced to make a decision as to which way to go to reach air. The correct path was initially easily identifiable by the higher

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<sup>17</sup> Ibid., p. 300.

<sup>18</sup> U. S. Naval School of Aviation Medicine Report No. 55-7, Flight Failure: Point of Attrition and Cause, by J. A. Creelman, p. 2, 2 June 1955.





illumination level which led to the surface of the water whereas the second and darker path led to a closed door and consequently no air. The rats were kept submerged for various time periods, thus altering both their motivation and state of anxiety. Furthermore, the illumination level of the correct door could be changed to simulate three levels of task difficulty. It was observed that optimum performance was elicited when the rat was held underwater for the longer time period with the highest level of door illumination. As the task became harder, a drastic decline in performance was evident. It was therefore concluded that high anxiety for the easier tasks facilitated learning but became a definite obstacle for the more difficult tasks.<sup>19</sup> This experiment supported the theory of Yerkes and Dodson which states that optimum motivation for learning decreases with increasing task difficulty.

#### D. REINFORCEMENT AND ANXIETY

Research by Mandler and Sarason confirms "that if the anxiety generated by perceived failure of an item were great enough, errors will persevere, and a general decrement in performance will result".<sup>20</sup> Feedback from previous experience has a direct relationship to level of anxiety and consequently performance. In a recent experiment by Fremont,

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<sup>19</sup> Murray, E. J., Motivation and Emotion, p. 12, Prentice Hall Inc., 1964.

<sup>20</sup> Terry, R. L. and Isaacson, R. M., "Item Failure and Performance on Subsequent Items of an Achievement Test", The Journal of Psychology, v. 77, p. 29, 1971.



Means, and Means (1970), an investigation was made to determine the effect that various types of feedback might have on anxiety level.<sup>21</sup> The results were conclusive emphasizing that the anxiety measure exerted by the subjects was dependent on the differences in applied feedback. Specifically, the negative feedback raised anxiety substantially whereas anxiety was lowered with positive feedback. Likewise, integral to the level and significance of anxiety is the consequence of feedback or reinforcement provided by the instructor pilot. A flight student possessing high anxiety is possibly not only handicapped in the learning process, but negative reinforcement from an instructor pilot also raises that anxiety and his comprehension is further impeded. The strange new environment of flying is a stimulus which raises the anxiety level in every human being.

"Initially, everything is alien to the student aviator; the plane seems to have a will of its own, the clouds are enormous, and nothing on the ground looks familiar. On the first few flights in the cockpit, the student is rigid; he seems to feel that if he moves or jostles the instruments the aircraft will come tumbling from the sky. His grip on the controls is like a 'death grip'. He seems to be trying to hold the plane in the air by this one control."<sup>22</sup>

In addition to the anxiety provoking experience of flight itself,

"throughout training the student displays numerous feelings of anxiety for other reasons and these may severely handicap the display of his capacity or even ruin it. Among them is a fear

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<sup>21</sup>Fremont, T., Means, G., and Means, R., op. cit., p. 455.

<sup>22</sup>Tucker, G. J., "Vertigo and Anxiety", Approach, p. 14, February, 1968.



that his achievements may be graded below standard, the fear that he may be embarrassed due to inadequate ability with consequences on his further career, or the fear, due to various reasons, of his instructor".<sup>23</sup>

There are two basic psychological methods purported to change or alter this behavior.

"Psychotherapists have used a conditioning technique very similar to classical conditioning in which they induce a feeling of total relaxation in the subject and then have him conjure up certain problem situations which are ordinarily anxiety provoking."<sup>24</sup>

This pairing of the situation and the feeling of relaxation aids the subject in relieving previously anxious experiences. Unfortunately, it should probably be administered only by trained therapists and therefore is impractical for use by a flight instructor.<sup>24</sup>

Fortunately, B. F. Skinner's work with operant behavior where reinforcement occurs after the desired task performance provided a powerful and much more practical means of manipulating desired behavior. "Operant behavior tells us to selectively support or reward the desired behavior and let other behavior extinguish."<sup>25</sup>

The anxiety of learning a new motor task is extreme and thus a calm and positive reinforcing instructor is indeed desirable. This is true

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<sup>23</sup>Steininger, K., "Psychological Factors in the Training of Student Pilots", In: Cassie, A., Fokkema, S. D., and Parry, J. B., Aviation Psychology, p. 25, Mouton and Company, 1964.

<sup>24</sup>Senger, J. D., "A Challenge from Behavioral Science: Can You Eliminate the Negative?", Supervisory Management, March, 1973.

<sup>25</sup>Ibid.



especially in the case of the highly anxious individual. The loss of the student's self-confidence and the lack of control over his environment usually evokes a large number of errors.

"His thought processes cannot keep up with the rapidly changing situation and the overwhelming number of tasks that must be handled within a short span. His anxiety brings about physiological changes in his body. His heart rate increases, his blood pressure rises, his skin becomes clammy and his mouth becomes dry. His perceptual and motor channels may become disrupted. Under these circumstances a calm word from an understanding instructor may bring him through the crisis and allow him to gain control of the situation. Such confidence building will create a foundation for his future handling of emergency situations. On the other hand, an excited or angry voice on the intercom at such times may do irreparable damage to the flight student's self confidence."<sup>26</sup>

So the flight instructor assumes a tremendous burden in which he must judge a student and either recommend him for further training or else disqualify the student and possibly terminate any further flight training. To place this onus on an instructor with little or no psychological training tends to verge on the ludicrous. Currently, Naval flight instructors go through an indoctrination course, or "charm school" as it is referred to, but the emphasis on educational psychology is scarcely satisfactory. Examination of the past twenty years of Approach and Naval Air News, the two most widely read official periodicals of the Naval Aviation community, contained little material on this subject. Only a few scattered articles were found in the Naval Training Bulletin, a magazine rarely read or available to instructor pilots. Instructor pilots in fleet squadrons are

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<sup>26</sup> Alkov, R. A., op. cit., p. 30.





even less indoctrinated and usually are chosen on the basis of rank and experience alone. Naval Aviation Training by no means is the only guilty institution, as educational learning theory is sadly neglected in teacher training throughout America's school system.

The psychologically aware instructor should be thoroughly familiar with and skilled in the use of the principles of operant conditioning. He should be able to empathize the feelings of each student on an individual basis and adjust his teaching methods correspondingly. He must be aware that in the vast majority of cases, to become outraged or impatient could be extremely detrimental to the student pilot.

#### E. STRAIT AND TRAIT ANXIETY

Two hypotheses have arisen regarding the nature of anxiety as measured by the Taylor Manifest Anxiety Scale (TMAS). The one which Taylor originally purported to favor was that the TMAS measured chronic anxiety. The scores were believed to reflect differences in chronic emotional states or show as a trait a certain level of anxiety. Thus differences in performances between high anxiety groups and low anxiety groups should be discovered whether or not there exists any stress or fear.<sup>27</sup> Taylor later reported that the TMAS instead measures emotional reactivity and that differences in performance should only occur when some form of

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<sup>27</sup> Stanton, H. E., "The Taylor Scale - A Measure of Chronic Anxiety or of Emotional Reactivity?", Australian Journal of Psychology, v. 23, p. 70, 1971.



threat or stress exists.<sup>28</sup> Experiments by Dargel and Kirk<sup>29</sup> and Stanton<sup>30</sup> have since both supported the latter theory that the TMAS measures emotional reactivity.

Such differences in anxiety precepts have induced additional work to analyze anxiety in depth. Of specific interest is the trait-state concept of anxiety. Using factor-analytic methods, Cattell and Scheier empirically isolated two distinct anxiety factors now referred to as state and trait anxiety.<sup>31</sup>

"Spielberger (1966) has recently proposed a theoretical conceptualization of anxiety phenomena that also posits two anxiety constructs. Following the terminology of Cattell and Scheier (1961), these constructs are labeled state anxiety (A-state) and trait anxiety (A-trait)."<sup>32</sup>

Cattell and Scheier formulated that trait anxiety describes the normally suppressed level of anxiety which is present in everyone at various relatively constant levels. Spielberger refers to trait anxiety (A-trait) as:

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<sup>28</sup> Spence, J. T. and Spence, K. W., op. cit., p. 291.

<sup>29</sup> Dargel, R. and Kirk, R. E., "Manifest Anxiety, Field Dependency and Task Performance", Perceptual and Motor Skills, v. 32, p. 383, 1971.

<sup>30</sup> Stanton, H. E., op. cit., p. 69.

<sup>31</sup> Cattell, R. B. and Scheier, I. H., The Meaning and Measurement of Neuroticism and Anxiety, Ronald Press, 1961.

<sup>32</sup> Johnson, D. T., "Effects of Interview Stress on Measures of State and Trait Anxiety", Journal of Abnormal Psychology, v. 73, p. 245, 1968.



"relatively stable individual differences in anxiety proneness, that is to differences between people in the tendency to respond to situations perceived as threatening with elevations in A-state intensity".<sup>33</sup>

State anxiety (A-state) is conceptualized as:

"a transitory emotional state or condition of the human organism that is characterized by subjective, consciously perceived feelings of tension and apprehension, and autonomic nervous system activity. A-states may vary in intensity and fluctuate over time".<sup>33</sup>

Spielberger further clarifies the difference between A-trait and A-state

by describing their relationship as analogous in certain respects to the

relation between the physical concepts of kinetic and potential energy.

"State anxiety, like kinetic energy, refers to an empirical process or reaction which is taking place now at a given level of intensity. Trait anxiety, like potential energy, indicates a latent disposition for a reaction of a certain type to occur if it is triggered by appropriate (sufficiently stressful) stimuli."<sup>34</sup>

A-trait reflects anxiety-proneness and perceived dangerous situations are responded to with an appropriate A-state level. In agreement with the suppositions of Spence and Spence, differences in task performance for high and low A-trait individuals are usually found under conditions of failure or ego involvement.

"From the standpoint of a trait-state conception of anxiety, the most important stimuli are those which produce differential changes in A-state in individuals who differ in A-trait. There is yet little experimental evidence that bears directly on the identification of such stimuli, since most experimental investigations have been concerned with A-state or A-trait, but rarely with both."<sup>35</sup>

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<sup>33</sup> Johnson, D. T., "Effects of Interview Stress on Measures of State and Trait Anxiety", *Journal of Abnormal Psychology*, v. 73, p. 245, 1968.

<sup>34</sup> Spielberger, C. D., "Theory and Research on Anxiety", In: Spielberger, C. D., *Anxiety and Behavior*, p. 5, Academic Press, 1966.

<sup>35</sup> Ibid., p. 19.



## F. EXPERIMENTAL INVESTIGATIONS OF ANXIETY

A significant portion of the research done on the general subject of anxiety has concentrated on proving, disproving, or altering these concepts and theories. The great majority of the conclusions have overwhelmingly verified that there is a high degree of interaction between anxiety and learning and that generally the high anxious groups performed better on the simpler tasks and worse on the complex tasks. Whether this is due to the Hull-Spence concept (anxiety is an internal emotional response which contributes to the drive level of the individual and interacts with response elements of the most dominant response) or the Mandler-Sarason theory (anxiety arouses task-relevant or task-irrelevant responses and that perception of failure results in performance decrement for high anxious individuals) is disputable and most likely the combined result of both phenomena.

There have been numerous studies accomplished on students at all levels of education to evaluate these relationships. The most pessimistic at least indicated that a connection of some kind between anxiety and both IQ and achievement did exist. The method of measuring anxiety in most of these cases made use of the personality-type test.

In 1952, the results of experimentation by J. D. Lucas showed that failure produced deterioration in the performance of anxious subjects and improvement in the performance of the low anxiety group.<sup>36</sup> This same

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<sup>36</sup>U. S. Air Force School of Aviation Medicine, Psychiatric Screening of Flying Personnel, by W. H. Holzman, 1952.





hypothesis was supported by Montague. He devised three lists of nonsense syllables of different levels of difficulty. The results were similar and as expected, the anxious students performed better on the easier lists but worse on the more difficult list.<sup>37</sup>

Anxiety was shown to be a factor in the performance of motor tasks as well as in the accomplishment of learning. An investigation in 1956 by Matazarro, Ulett, and Saslow studied the relationship between anxiety level and performance. The subjects were divided into high and low-anxiety groups in accordance with scores received on the Taylor Manifest Anxiety Scale. Each subject was then blindfolded and instructed to perform at a stylus maze. The result was the same as that theorized for high-anxiety subjects on a relatively complex task. The high-anxiety group took approximately thirty trials to reach the criterion whereas the low-anxiety group took less than twenty-two.<sup>38</sup>

Helen G. Price reported similar findings using high and low anxiety subjects and then testing their ability to perform a motor task. A Turret Pursuit Apparatus was used and thirty-second trial periods observed where the subject manipulated controls to keep the turret aimed at the target. The controls were later reversed so that the manipulation became

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<sup>37</sup> Montague, E. K., "The Role of Anxiety in Serial Rote Learning", Journal of Experimental Psychology, v. 57, p. 329, 1959.

<sup>38</sup> U. S. Air Force School of Aviation Medicine, Adaptability Screening of Flying Personnel, Human Maze Performance as a Function of Increasing Levels of Anxiety, by Matarazzo, J. D., Ulett, G. A., and Saslow, G., p. 8, 1956.



more difficult. Significant differences between the tasks were not observed most likely because of the relatively complex performance required for either manipulation.<sup>39</sup>

In 1954, a study by Hammock and Prince attempted to determine the effect of anxiety and stress on marksmanship. Again the subjects were divided into two groups on the basis of scores received on the Taylor Manifest Anxiety Scale. The results in this experiment were more pronounced, with the high-anxiety subjects less proficient with the M-1 rifle than those of low anxiety. It was also observed of the high-anxiety group that when a time limit was placed on them, the results were greater constant error and more fumbling while changing clips.<sup>40</sup>

The empirical evidence convincingly supports the theory that the highly anxious individual, although performing better on simpler tasks, will not achieve as high an index of performance on the more complex tasks. And even those tasks which are not as difficult become troublesome for the highly anxious individual with the addition of stress.

Unfortunately it is not possible to simply classify piloting an aircraft as a complex task and therefore conclude that the individual should be disqualified from the flight program if he possesses high anxiety. It

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<sup>39</sup> Air Training Command Resources Research Center, Anxiety and Failure as Factors in the Performance of Motor Tasks, by Helen G. Price, p. 15, 1952.

<sup>40</sup> George Washington University Human Resources Research Office, A Study of the Effects of Manifest Anxiety and Situational Stress on M-1 Rifle Firing, by Hammock, J. C. and Prince, A. I., p. 2, 1954.



must be empirically determined if state and trait anxiety have any relationship to flight performance. To succeed with this examination, three basic requirements must be met. The scale used to measure the anxiety must be valid, the flight grades must represent how the student performed relative to the other students, and the relationship between the two must be strong enough not to be overshadowed completely by differences in motor skills and intelligence.



### III. PSYCHOLOGICAL TESTING FOR FLIGHT CANDIDATE SELECTION

Early selection of candidates for flight training was initially a non-chalant process. Screening consisted of little more than passing a physical examination and meeting physical fitness requirements. Interviews by Naval Line Officers were added with the advent of the Naval Aviation Cadet program in the mid-1930's but it was not until 1941 that serious research began on the selection and training of pilots. In December of 1941, three pencil and paper tests were introduced as initial screening devices designed to "consistently and reliably differentiate between groups who passed and ultimately failed in Naval Aviation Training".<sup>41</sup> These tests purported to measure general intelligence, mechanical comprehension, and biographical data. These tests were replaced in 1942 by the Aviation Classification Test and the Biographical Inventory. The latter test was the first attempt to determine the aptitude of flight students by means of a test requiring subjective answers relating to interests, habits, attitudes, and preferences.

In a report released in late 1953, the examination of two groups of Naval Aviation Cadets using the California F Scale and the Taylor Manifest Anxiety Scale was described. The results yielded a positive

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<sup>41</sup>"The Predictive Value of Naval Aviation Cadet Selection Tests", Navy Department, BuMed Newsletter, v. 8, March, 1947.





correlation of .22 in determining the relationship between anxiety and authoritarianism. Worthy of note was the distribution of the TMAS scores with a median of approximately six and skewed toward low anxiety.<sup>42</sup> Because the TMAS is fakeable, the highly motivated and psychologically aware flight students might have answered the scale as they perceived the ideal Naval Aviator might answer instead of divulging their true feelings.

Further research was completed in 1957 at the U. S. Naval School of Aviation Medicine. This study was designed to study the validity of several standard objective inventories for attrition in flight training. The Minnesota Multiphasic Personality Inventory (MMPI), the Guilford-Zimmerman Temperament Survey (GZTS), the Taylor Manifest Anxiety Scale (TMAS), the Heineman Manifest Anxiety Scale (HMA), and the Saslow Screening Test (SST) were administered to Naval Aviation Cadets. The latter three claimed to measure anxiety. When the results were compared to those of college students, significant differences were noted between the TMAS and the HMA scores although the correlation between the two scales themselves is substantial. "The fact that the cadets demonstrated lower anxiety scores only on the scale whose mean can be affected by faking (TMAS), suggests that it is this factor rather than a true difference in the level of manifest anxiety that accounts for the

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<sup>42</sup>U. S. Naval School of Aviation Medicine Report No. NM 001 058.25.03, Aspects of the Autonomous Personality: I. Manifest Anxiety, by Marshall Jones, p. 3, 12 November 1953.



apparent difference between cadets and college students."<sup>43</sup> The HMA , which supposedly is insensitive to faking, revealed that anxiety tended to increase through pre-flight as measured by students who separated from pre-flight training. Although the report suggested that this was due to increased stress as the flight phase of training approached, also probable is the explanation that the separated students answered with more candidness as they had little more to lose.

In May of 1966, five scales were evaluated for use as predictors of flight training attrition. Two tests, the Taylor Manifest Anxiety Scale (TMAS) and the Alternate Manifest Anxiety Scale (AMAS) were administered to measure anxiety. The latter test was developed in Pensacola as an alternate to the TMAS. The only significant correlation found (using three dichotomous criteria of pass/fail, pass/drop, and pass/attrite) was a negative .158 between the TMAS and the pass/drop criterion. "This is the highest relationship of any of the predictors of voluntary withdrawal and is consistent with the expectation that students showing higher levels of anxiety are more likely to drop voluntarily than students with lower anxiety."<sup>44</sup>

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<sup>43</sup>U. S. Naval School of Aviation Medicine Report No. 13, Validity of Personality Inventories in the Naval Aviation Selection Program, by R. B. Voas, J. T. Bair, and R. K. Ambler, p. 3, 15 November 1957.

<sup>44</sup>U. S. Naval School of Aviation Medicine Report No. 968, The Relationship of Five Personality Scales to Success in Naval Aviation Training, by H. L. Fleishman, R. K. Ambler, F. E. Peterson, and N. E. Lane, p. 4, 24 May 1966.



The latest attempts to measure anxiety for use as a predictor in flight training have used the State-Trait Anxiety Inventory (STAI).<sup>45</sup> Aviation Officer Candidates (AOC) and college students were given the STAI but no correlation with a criterion was attempted.<sup>46,47</sup> Further analysis of their results appears in a later section of this paper.

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<sup>45</sup> Spielberger, C. D., Gorsuch, R. L., and Lushene, R. E., STAI Manual, p. 3, Consulting Psychologists Press, Inc., 1970.

<sup>46</sup> U. S. Naval School of Aviation Medicine Report No. 1132, State and Trait Anxiety in the Student Naval Aviator Who Voluntarily Withdraws from Flight Training, by S. F. Bucky and C. D. Spielberger, p. 3, April 1971.

<sup>47</sup> U. S. Naval School of Aviation Medicine Report No. 1125, State and Trait Anxiety in Student Naval Aviators, by S. F. Bucky, C. D. Spielberger, and R. M. Bale, p. 1, December, 1970.



#### IV. EXPERIMENTAL PROCEDURE

The most comparable measure of a student's performance is the flight grades acquired for each flight while progressing through the training command. Because of a high degree of flight instruction standardization and sufficient instructor changes for each student, flight grades were used as a criterion to test the initial hypothesis. If high anxiety lowered the student's ability to demonstrate his aeronautical expertise, then the variance of flight grades would be the best indicator of anxiety's effect thereon. Measurement of the anxiety experienced by a student pilot must be reliable and must accurately gauge its level at situations as comparable as possible. Consequently selection of a scale to best measure anxiety was of the utmost importance.

To support or refute the second hypothesis, it must be determined if the high anxiety student believes a "screamer" is a liability or an aide to his performance. A direct manner by which one could extract this belief was simply to inquire using the Supplementary Questionnaire. The comparative degree of anxiety-arousing behavior to which students feel an instructor incites to warrant the label "screamer" is irrelevant. It is the individual's perception of the instructor behavior which is important. Ideally to test the effect of a "screamer", we should compare a student's performance on flights where he did encounter such an





individual with those on which he did not. But because of the students understandable inability to recall accurate grades from specific hops with various instructors, this procedure was unfortunately impracticable.

#### A. TEST SELECTION

There are currently more than 120 personality tests using as many as 325 variables claiming to reflect anxiety.<sup>48</sup> The requirements and restrictions placed upon this research effort narrowed the search to less than six. Before choosing the most satisfactory of these, the most restrictive criteria needed review and consideration. The most important qualifications necessary were those of reliability and validity. In addition, the test had to fit the administrative requirements necessitated by relatively little time available for students undergoing flight training at Patrol Squadron Thirty-One. The test must also purport to relate anxiety most nearly as defined in this paper (state and trait anxiety).

Based on reliability, validity, reputation, and use in previous research, the Taylor Manifest Anxiety Scale would probably have been the best selection. A clear majority of empirical research conducted with anxiety has used the TMAS and many of the new anxiety tests use the TMAS for a criterion as to their own validity. This test has been extensively evaluated at the U. S. Naval School of Aviation Medicine as a

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<sup>48</sup>Spielberger, C. D., "Theory and Research on Anxiety", In: Spielberger, C. D., Anxiety and Behavior, p. 7, Academic Press, 1966.



possible predictor of flight training success but none of the results have been significant.

The State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, 1970), the Costello-Comrey Anxiety Scale, the Test Anxiety Scale (Sarason and Ganzer, 1962), and the IPAT Anxiety Scale (Cattell and Scheier, 1963) all are accepted as valid indicators of anxiety and were given further consideration because of their relatively short administration time.

Finally, the State-Trait Anxiety Inventory (STAI) was chosen as the predictor for this research. Fulfilling all previously referred to requirements, the STAI has been used in similar experiments, is conveniently accessible, uses the same concepts of anxiety as defined in this paper, and correlates highly with the IPAT Anxiety Scale, the Taylor Manifest Anxiety Scale, and others.<sup>49</sup>

Physiological tests are also numerous and have been proved valid; however difficulties in administration, interpretation, and economic suitability have eliminated any possibility of their use in this research effort.

## B. SUPPLEMENTARY QUESTIONNAIRE

The primary purpose for the Supplementary Questionnaire was to acquire the criterion variable, flight grades, for use in a linear regression

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<sup>49</sup> Spielberger, C. D., Gorsuch, R. L., and Lushene, R. E., STAI Manual, p. 7, Consulting Psychologists Press, Inc., 1970.



model. Additionally, other questions indicating possible states of anxiety were asked.

Question one indicated only if the student was a newly designated Naval Aviator or whether he was obtaining refresher training prior to his second tour. These pilots, possibly six or more years removed from the Training Command, needed identification as grading standards had since changed. This data did provide a general notion, however, that the anxiety scores as measured by the STAI were not significantly altered by experience, though no concrete conclusions could be drawn because of the small number of experienced pilots' test scores.

The second question was most important, as these flight grades formed the criterion variable for this research. Questions three, four, five, and twelve evolved from observations by K. Steininger, an ex-World War II Luftwaffe fighter pilot and now a prominent psychologist for Luft-hansa.<sup>50</sup> Although based on Steininger's own experience as a flight instructor and not verified by empirical investigation, content validity is reinforced by informal interviews with experienced flight instructors at Patrol Squadron Thirty-One.

Question five was thought to be of possible value because many of the studies previously referred to showed a definite relationship between the ability to perform simple alignment operations and various levels of anxiety. For complex tasks, the higher the anxiety, the longer it took to perform the alignment operation.

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<sup>50</sup> Steininger, K., op. cit., p. 35.



Question six and ten allowed for a comparison between the flight grades attained on flights on which the student indicated an unqualified flight or on which he had a "screamer" as an instructor.<sup>51</sup>

Questions seven and nine are alternate means of indicating stages of flight instruction which might possibly have been made less enjoyable by various anxiety raising factors.

Questions eleven and thirteen are simply indicators of motivation and experience and bear no direct complement to the data gathered.

Question fourteen inquired as to how a "screamer" affects the student's flight performance and primarily was used to substantiate the second hypothesis. The remaining questions were used to provide an indication of how the B-26 check flight grade might differ from the other grades received in that stage of flight training as a result of a "screamer" as an instructor.

The background information provided by the Supplementary Questionnaire additionally identified moderator variables used to employ multi-dimensional scatterplotting techniques. In future research, a similar questionnaire could be used as an indicator of the anxiety test's fake-ability. Mean group flight grades could be compared with those flight

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<sup>51</sup>An unqualified flight is a graded hop in which one or more specific maneuvers were performed unsatisfactorily and consequently the flight must be repeated at a later date. The term "screamer" is commonly used jargon for an instructor pilot who frequently loses his temper and indicates flight errors to the student in a verbose and unsympathetic manner.





grades transcribed in existing flight records and their similarity used as an index to describe how honestly the students responded to the test.

Assuming that the students answered the test as candidly as they did the questionnaire, the comparison might indicate the extent to which the defensive tendency to "look good" was employed.

### C. SUBJECTS

The  $S_s$  for the test were 73 male Naval Aviators undergoing flight training at Patrol Squadron Thirty-One, Naval Air Station, Moffett Field, California. Patrol Squadron Thirty-One is the Replacement Air Group (RAG) on the west coast of the United States. Their primary mission is to provide replacement P-3 Orion pilots for Naval fleet squadrons. Most of the students were between 22 and 26 years of age and had recently earned their Naval Wings (designated a Naval Aviator). Seven of the students were fleet experienced personnel returning for a second tour in the P-3 aircraft or who were transitioning from various other aircraft.

The State-Trait Anxiety Inventory and the Supplementary Questionnaire were administered to these students to obtain information for data analysis.

### D. TEST ADMINISTRATION

The STAI and Supplementary Questionnaire were administered on 14 March, 1973, for a pilot study and through 25 April, 1973, for the remaining students. Administration of the tests was generally as recommended



in the STAI Manual.<sup>52</sup> Digressions from standard instructions are emphasized in this section.

The students were told that the purpose of the tests was to provide data for empirical research and were at no time privileged with the information that the tests were designed to measure anxiety. The test was consistently referred to as the Self Evaluation Questionnaire, the title printed on the test form.

Two instructions were emphatically stressed to the subjects. The first was that no names were required nor desired, that no test results would in any manner be entered on any personal flight records, and that current flight training at Patrol Squadron Thirty-One would not be affected by the results. The second instruction was to answer the questions as their recall and emotions dictated and not as they might believe a Naval Aviator should answer them. The cover sheet with instructions is provided in Appendix A.

In accordance with the STAI Manual, the A-state scale was given first. Directions on this test were modified to read as follows:

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you felt just prior to the final check in the "B" stage of Advanced Flight Training (B-26X). There are no wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you felt at the time best.

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<sup>52</sup>Spielberger, C. D., Gorsuch, R. L., and Lushene, R. E., STAI Manual, p. 29, Consulting Psychologists Press, Inc., 1970.



In a related study, Aviation Officer Candidates (AOC) were given the A-state portion of the STAI with the instructions to answer "as if you had just landed on an aircraft carrier".<sup>53</sup> This instruction was not used here because the grandeur associated with carrier landings might overshadow the student's respect for its dangers.

From the research of Cattell and Scheier it was learned that anxiety is highest before the examination period or stress evoking situation and then falls at the test itself.<sup>54</sup> Therefore the students in this study were instructed to answer indicating their feelings just prior to their B-26 check flight. The B-26 check flight provides a common situation to evaluate the level of A-state intensity as well as comply with recommendations in the STAI Manual that the experience be recent. Most of the students tested had flown the subject flight within the past six months. Because of changes in the Advanced Training syllabus and the lengthy period of time elapsed since flight training had been completed for some of the pilots, it was requested that they substitute their latest NATOPS check flight in the aircraft most recently flown in place of the B-26 check flight.<sup>55</sup>

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<sup>53</sup>U. S. Naval School of Aviation Medicine Report No. 1125, State and Trait Anxiety in Student Naval Aviators, by S. F. Bucky, C. D. Spielberger, and R. M. Bale, p. 1, December, 1970.

<sup>54</sup>Scheier, I. H. and Cattell, R. B., The Neuroticism Scale Questionnaire, IPAT, 1961.

<sup>55</sup>The NATOPS check is an annually required flight of which successful completion qualifies the pilot to solo the applicable aircraft.



It was emphasized that the pilots must concentrate and attempt to recall as accurately as possible exactly how they felt prior to this check flight. The emphasis provided on this point and the instruction for anonymity hopefully provided honest and candid responses.

The second test administered was the A-trait scale. Directions remained as printed on the test form which required the subjects to answer the questions indicating how they feel generally.

Upon conclusion of the testing, the Supplementary Questionnaire (Appendix B) was distributed. Data supplied here was required for both biographical purposes and for subjective assertions with regards to the STAI test scores. Total time for the test and questionnaire administration was less than twenty minutes. Test results appear in Appendixes D, E, F, and G.





## V. RESULTS

Assuming the relationship of flight grades and level of anxiety to be linear and homoscedastic, classical lineal regression techniques were applied to the data.<sup>56</sup> To help eliminate the possibility that the test instrument was an insensitive measure of anxiety, its split-half reliability was determined using the Spearman-Brown formula.<sup>57</sup> The A-state reliability was computed to be 0.9371 and the A-trait reliability computed to be 0.8839. Consequently, the maximum validity using these tests which could be found was 0.968 and 0.940 respectively.<sup>58</sup>

Of seventy-three students tested, useful information was retrieved from sixty-five. Eight were eliminated because of incomplete, invalid, or incomparable flight grades. The criterion variable, flight grade average, was regressed against both the A-state and A-trait test scores. The following table summarizes the statistical results.

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<sup>56</sup> Data was evaluated using the IBM sub-routine REGRE at the U. S. Naval Postgraduate School, Monterey.

<sup>57</sup> Dunnette, M. D., Personnel Selection and Placement, p. 32, Brooks/Cole Publishing Company, 1966.

<sup>58</sup>  $r_{T,C} = \frac{r_{pc}}{\sqrt{r_{pp}}}$  and maximum  $r_{T,C} = 1$ ; therefore  $r_{pc} \leq \sqrt{r_{pp}}$



TABLE I.

Linear Correlation between A-state and A-trait  
Predictors and Average Flight Grades. (N=65)

Predictor	Mean	SD	$r_{pc}$	t	F*
A-state	46.29	10.77	-.019	-.151	.0228
A-trait	32.15	5.65	.015	.122	.0148
A-state & A-trait			.028		.0248

\*Using 1 and 64 degrees of freedom, approximately 4.0 F value necessary for significance at .05 level.

Regression analysis was also conducted using the same predictors but separating the criterion into either T-34, T-28, TS-2, or TS-2 "B state" grades.<sup>59</sup> The following table summarizes these results.

TABLE II.

Linear Correlations between A-state and A-trait  
Predictors and Flight Grades by Aircraft (N=61)

Ind. var.	dep. var.	$r_{pc}$	t	mult. $r_{pc}$	F*
A-state	T-34	-.1438	-1.116		1.247
A-trait	T-34	-.0749	-.5775		.333
both	T-34			.15015	.668
A-state	T-28	-.2111	-1.658		2.752
A-trait	T-28	-.1184	-.9164		.839
both	T-28			.22297	1.517
A-state	TS-2	-.0509	-.3916		.153
A-trait	TS-2	-.1632	-1.270		1.614
both	TS-2			.16377	.799
A-state	"B stage"	-.0579	-.4461		.199
A-trait	"B stage"	-.0614	-.4726		.223
both	"B stage"			.07616	.169

\*Using 1 and 64 degrees of freedom, approximately 4.0 F value necessary for significance at .05 level.

<sup>59</sup> Breakdown of flight grades into components was suggested by Dr. Gallagher and Dr. Lane at the U. S. Naval School of Aviation Medicine, Pensacola.



The higher correlation between T-28 flight grades and A-state test scores can possibly be attributed to the advance in aircraft sophistication and corresponding procedures confronted when transitioning from the T-34 to the T-28. The T-28, although primarily a training aircraft, is capable of out-performing many WWII fighter aircraft and this presents a substantial progression to the flight students. Additionally, the student is introduced to instrument flight procedures in the T-28 and it can be assumed that anxiety is raised when the canvas hood restricts the student's vision to everything but his instruments.

The flight students were also screened and those individual raw scores on the A-state and A-trait tests which differed by more than ten were isolated. (See d-values, Appendixes C, D, E, and F). The idea for this trial originated from Speisman who noted that "the same stimulus may be either a stressor or not, depending on the nature of the cognitive appraisal the person makes regarding its significance for him".<sup>60</sup> Spielberger also agreed with this concept. He concluded: "but whether or not people who differ in A-trait will show corresponding increases in A-state depends upon the extent to which a specific situation is perceived by a particular individual as dangerous or threatening, and this is greatly influenced by an individual's past experience".<sup>61</sup>

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<sup>60</sup> Speisman, J. C., Lazarus, R. S., Mordkoff, A., and Davison, L., "Experimental Reduction of Stress Based on Ego-defense Theory", Journal of Abnormal and Social Psychology, v. 68, p. 367, 1964.

<sup>61</sup> Spielberger, C. D., Gorsuch, R. L., and Lushene, R. E., STAI Manual, p. 3, Consulting Psychologists Press, Inc., 1970.



Consequently it was felt that possibly some of the students did not feel that the B-26 check flight was sufficient stimulus to warrant a rise in anxiety. It was also possible that these individuals lacked a sufficient sense of imagery to revive their thoughts and emotions which had occurred six months prior. With the test scores differing by less than ten removed, a sample of forty was statistically analyzed. The following table summarizes these results.

TABLE III.

Linear Correlation between A-state and A-trait  
Predictors Whose d-Values Exceeded Ten and  
Average Flight Grades. (N=40)

Predictor	Mean	SD	$r_{pc}$	t	F*
A-state	51.67	8.97	.036	.224	.0504
A-trait	30.92	4.66	.183	1.147	1.3166

\*Using 1 and 39 degrees of freedom, approximately 4.08 F value necessary for significance at .05 level.

Analyzing the scatter diagrams proved unproductive. No curvilinear relationships were evident and thus the correlation ratio eta was not calculated. It was also apparent that Paris' findings that student pilots who scored very high or very low on their phase checks exhibited high anxiety levels as measured by the TMAS prior to phase checks was unsupported by this analysis.<sup>62</sup>

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<sup>62</sup> Department of Aviation Medicine, Aviation, Psychology and the Computer Center, Ohio State University, Progress Report No. RF 1857-6, Studies of Pilot Performance and Stress in Student Pilots, by C. E. Billings, p. 31, March 1970.





The subjects were also divided into two groups of high anxiety (more than one standard deviation above the mean) and low anxiety (more than one standard deviation below the mean). For both A-state and A-trait data, the average flight grade was almost identical.

TABLE IV.

Analysis of Mean Flight Grades for High and Low Anxiety Groups as Measured by the STAI.

A-state		
	High Anxiety (N=12)	Low Anxiety (N=8)
Mean Flight Grade	3.050	3.046
A-trait		
	High Anxiety (N=8)	Low Anxiety (N=11)
Mean Flight Grade	3.063	3.056

It is obvious that correlation coefficients using point bi-serial methods would also be insignificant.

In that thirty-nine of the seventy-three students tested volunteered the information that they had received at least one "down" or unsatisfactory flight and sixteen indicated two or more unsatisfactory flights, it is assumed that the rest of the questions on the STAI and the questionnaire were answered with similar candidness and honesty. Further evidence for this assumption is apparent when the mean score for the STAI is compared to the results of identical tests given in late 1970 to 135



AOC's.<sup>63</sup> It is meaningful to note that the mean of the A-state scores of the AOC's is significantly lower than the mean obtained in this research. (See Table V.)

TABLE V.

Mean and Standard Deviations of A-state and A-trait Scores on AOC's and Patrol Squadron Thirty-One Flight Students.

AOC's (N=134)	Mean	SD
A-state	37.95	8.96
A-trait	31.54	7.32
VP-31 students (N=65)		
A-state	46.29	10.76
A-trait	32.15	5.65

Spielberger attributed the AOC's low A-state scores to the realization that "when confronted with a situation in which they feel particularly vulnerable and where their entire future may be at stake, the defensive tendency to 'look good' increases and anxiety is denied".<sup>64</sup> It was concluded therefore that the new scores represent a true measure of the predictor unaffected by student concern over reprisal.

<sup>63</sup> U. S. Naval School of Aviation Medicine Report No. 1125, State and Trait Anxiety in Student Naval Aviators, by S. F. Bucky, C. D. Spielberger, and R. M. Bale, p. 2, December 1970.

<sup>64</sup> Ibid., p. 2.



Thirty-three of the students tested were administered the second page of the Supplementary Questionnaire (Appendix C). These questions were designed to investigate if a high- or low-anxiety flight student felt hampered or helped by a flight instructor who was a "screamer". Classifying the thirty-three students into high (those more than one standard deviation above the mean), low (those more than one standard deviation below the mean), and medium (all others) categories in accordance with their STAI scores, the subjective impressions were recorded. Results are tabulated in Table VI on the following page.

As expected, no student regarded a "screamer" as helpful and only one medium anxiety student believed that the "screamer" did not affect his performance at all.

One thing is apparent: the "screamer" has no place in the education and training of aviators. The March 1973 issue of Naval Aviation News stated that "the 'screamers' are a thing of the past"<sup>65</sup>; however, the results of the supplementary questionnaire tend to disagree as 56 of the 73 students indicated flying with at least one "screamer" and 17 perceived two or more. The "screamer" apparently still exists much to the dismay of the educational psychologist.

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<sup>65</sup> Mullane, P. N., "In Pursuit of Wings.. A Look at the Naval Air Training Command", Naval Aviation News, p. 16, March, 1973.



TABLE VI.

Subjective Evaluations of High, Medium, and Low Anxiety Students as Measured by the STAI on the Effect of Instructor Pilots termed "Screamers". (N=33)

A-STATE TEST	Subjective evaluation - "screamer" hampered:			
	tremendously	quite a bit	a little	not at all
High	1	2	2	0
Medium	8	11	2	1
Low	1	0	5	0
A-TRAIT TEST				
High	2	0	1	0
Medium	8	12	7	1
Low	0	1	1	0
A-STATE TEST				
	Subjective evaluation - "screamer" helped:			
	tremendously	quite a bit	a little	not at all
High	0	0	0	0
Medium	0	0	0	0
Low	0	0	0	0
A-TRAIT TEST				
High	0	0	0	0
Medium	0	0	0	0
Low	0	0	0	0





## VI. CONCLUSIONS

The initial hypothesis stated that the flight student who experiences a high state of anxiety would not perform as adeptly as the student experiencing a low state of anxiety. To analyze this phenomenon, concepts and theories of learning, anxiety, and their interaction were examined. Anxiety was further investigated and the concepts of state and trait anxiety defined for use in this research. Subsequent empirical analysis using flight grades as the criterion and the State-Trait Anxiety Inventory as the predictor partially supported this hypothesis. The results of regression analysis revealed that all of the correlations were negative. (See Table II.) The small sample size contributed to the lack of statistical significance found in the results; however, it is meaningful to note that the tendency was such that the higher the anxiety level, the lower the flight grades. These consistently negative correlations themselves would seem to justify the conclusion that the relationship between flight performance and student anxiety warrants further research.

The second hypothesis stated that a high-anxiety student will perform in an inferior manner when flying with a "screamer" as compared to that performance demonstrated while flying with an instructor pilot who is calm and understanding. The relative effects of positive and negative feedback on the learning process was discussed in Section IID, and the



effect this feedback might have on flight students possessing various levels of anxiety. With results from question fourteen of the Supplementary Questionnaire, it was determined that every student except one felt that the "screamer" hampered his ability to demonstrate his flying skills and none felt the "screamer" aided him whatsoever. Although the ideal analysis would consist of examinations of students' flight grades with and without a "screamer" as a flight instructor, smallness of sample size and student inability to recall specific flights and their grades eliminated this methodology from consideration.

There are a number of reasons why the initial hypothesis was not supported at a statistically significant level by this research. Assuming that a relationship does exist, it is possible that the State-Trait Anxiety scale does not adequately measure anxiety. There are also many shortcomings common to psychological tests of the pencil-and-paper variety. Discussed previously was the tendency for the student to falsify his answers in order to appear as well suited to aviation as possible. Additionally, most students are inclined to respond in the negative to an unpleasant item than to answer in the affirmative to the same item reversed. There is also the possibility of unintentional faking where the individual simply does not know himself well enough to answer factually and his responses prove to be self-deceptions or rationalizations. And there are individuals who tend to exaggerate their defects as their nature might be more self-analytic or introspective. For a test with four responses ranging from "not at all" to "quite often", some subjects tend to give



many more extreme responses than the middle answers. Finally the problem of semantic differences in question and answer interpretation leads to undesirable variance from true personality measurement.

The most serious limitation to the method utilized was the severe restriction in range of the criterion variable: flight grades. This undesirable factor was anticipated as students undergoing training to fly the P-3 aircraft are typically described as follows: (1) they have obviously survived the attrition which eliminates many of the higher-emotional and lower-ability individuals early in flight training, and (2) their flight grades have a tighter variance due to the tendency for high-grade students to follow the jet pipeline and low-grade students to follow the helicopter pipeline. Dunnette, in referring to the disadvantages of concurrent validation research such as this states:

"unfortunately, such studies probably underestimate the degree of the relationship between test scores and job behaviors because the sample of subjects will not usually include potentially less effective employees who were not hired or who have failed and been discharged."<sup>66</sup>

An additional handicap of attempts at concurrent validation is that "many test responses may be due to rather than predictive of current aspects of a person's behavior".<sup>67</sup>

#### A. SUGGESTIONS FOR FURTHER STUDY

Considerable changes could be made in the method employed to

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<sup>66</sup>Dunnette, M. D., op. cit., p. 114.

<sup>67</sup>Dunnette, M. D., op. cit., p. 115.



conduct this research which could possibly result in additional meaningful data. Concurrent use of paper-and-pencil tests and equipment designed to measure physiological phenomena associated with anxiety (though admittedly, a very expensive method) could serve to validate both tests. According to Spielberger, "the measurement of A-state requires concurrent assessment of both autonomic nervous system (ANS) activity and subjective feelings".<sup>68</sup>

Additionally, it would be extremely beneficial to obtain background data on the individuals which would indicate intelligence level and mechanical ability. Scores on the Aviation Qualification Test (AQT), the Mechanical Comprehension Test (MCT), and the Spatial Apperception Test (SAT) would serve as excellent moderator variables to permit analysis as perhaps a more influential variable.

To alleviate the restriction in range, the ideal procedure would be to test incoming students and follow their progress throughout flight training. Thus students who drop or who are disqualified as well as students in the jet and helicopter pipelines would be included.

If the measurement of anxiety could be refined to an unfakeable, consistent, and reliable predictor, if the relationship to flight performance could be empirically determined, and if the psychologically aware instructor pilot could modify his teaching methods to optimize each student's absorption of flying techniques, then the final result could be

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<sup>68</sup>Johnson, Dale T., op. cit., p. 245





the training of superior pilots with less wasteful attrition. The answers may be found only with further research.



## APPENDIX A Cover Sheet and Test Directions

This questionnaire is being administered to provide empirical data to support or refute hypotheses established in my thesis. I am presently at the Naval Postgraduate School working towards a Masters Degree in Personnel Management.

It is important to answer all questions as your recall and emotions dictate. The Self Evaluation Questionnaire should not be answered as you believe a Naval Pilot should answer, but exactly as your conscience directs.

It is emphasized that absolutely no names are required nor desired, that the results will not be entered on any personal flight records, and that current training at VP-31 will not be affected whatsoever. Your time, diligence, and concentration are most appreciated.

Please ensure that you take form X-1 first. Ignore the directions on this first side and substitute the following:

**DIRECTIONS:** A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you felt just prior to the final flight in the "B" stage of Advanced Flight Training (B-26X). There are no wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you felt at the time best.

For those pilots who are many years removed from the training command, please substitute the NATOPS check flight in the latest aircraft flown in place of the B-26X.

Instructions to Form X-2 remain as printed on the form.



## APPENDIX B Supplementary Questionnaire

1. Please indicate one: Replacement C/P\_\_\_\_. Replacement PPC\_\_\_\_.
2. Please indicate your flight grades as accurately as possible.  
T-34\_\_\_\_ T-28 Transition\_\_\_\_ TS-2 A stage\_\_\_\_  
B/I\_\_\_\_ B stage\_\_\_\_  
R/I\_\_\_\_  
Formation\_\_\_\_  
CarQuals\_\_\_\_
3. At the time you started flying the aircraft listed below, did you feel that any one of them was less mechanically reliable than were the others? If so, please indicate with an X next to the appropriate aircraft.  
T-34\_\_\_\_ T-28\_\_\_\_ TS-2\_\_\_\_ Other\_\_\_\_
4. Did you feel more confident and relaxed on solo flights as opposed to instructional flights? Yes\_\_\_\_ No\_\_\_\_
5. Did you find that overshooting courses, radials, center-lines, etc. was a problem? Never\_\_\_\_ Seldom\_\_\_\_ Occasionally\_\_\_\_  
Often\_\_\_\_
6. Have you ever had a "screamer" as an instructor? Yes\_\_\_\_ No\_\_\_\_  
If yes, please indicate stage(s) of flight training. (e.g. T-28 R/I).  
\_\_\_\_\_
7. Which aircraft did you most enjoy flying?  
T-34\_\_\_\_ T-28\_\_\_\_ TS-2\_\_\_\_
8. Was scan ever a problem throughout your flight training?  
Yes\_\_\_\_ No\_\_\_\_. If yes, please identify the aircraft(s) with which the problem was most prevalent.  
T-34\_\_\_\_ T-28\_\_\_\_ TS-2\_\_\_\_
9. Which stage of flying was most enjoyable to you?  
T-34\_\_\_\_ T-28\_\_\_\_ TS-2\_\_\_\_  
Please indicate your reasons:  
Better aircraft\_\_\_\_ Better instructor\_\_\_\_  
Better syllabus\_\_\_\_ Other\_\_\_\_
10. Have you ever received a "down" or "refly" while progressing through the training command? Yes\_\_\_\_ No\_\_\_\_. If yes, please indicate stage(s) of flight training. (e.g. T-34 Precision, TS2A B-stage)  
\_\_\_\_\_



11. Would you continue flying if flight pay was discontinued?  
Yes\_\_\_\_\_ No\_\_\_\_\_ Maybe\_\_\_\_\_
12. Have you ever been advised by an instructor pilot to ease up on the flight controls?  
Never\_\_\_\_\_ Seldom\_\_\_\_\_ Occasionally\_\_\_\_\_ Often\_\_\_\_\_
13. Have you ever had military flight instructor experience?  
Yes\_\_\_\_\_ No\_\_\_\_\_
14. A flight instructor who screams <sup>hampers</sup> helps my ability to fly.  
a. tremendously  
b. quite a bit  
c. a little  
d. not at all
15. If you remember your grade on your B-26X, please indicate it.  
If not, please indicate pass or refly. \_\_\_\_\_
16. The instructor on my B-26X was:  
a. a screamer  
b. an average instructor  
c. understanding and patient
17. The following are descriptors of flight instructors. Indicate with a check mark those which most nearly describe your B-26X pilot.  
Additional space is provided if you feel appropriate descriptors are not listed.

- \_\_\_\_\_ Good, but too impersonal  
\_\_\_\_\_ Always rides the controls  
\_\_\_\_\_ A good aviator, but unable to instruct  
\_\_\_\_\_ Shakes me up at times  
\_\_\_\_\_ Never positive, always negative  
\_\_\_\_\_ Demanding, but not unreasonable  
\_\_\_\_\_ Stern, impatient, harshly critical  
\_\_\_\_\_ Understanding and patient  
\_\_\_\_\_ A screamer  
\_\_\_\_\_ Made me nervous  
\_\_\_\_\_ Applied constant pressure  
\_\_\_\_\_ Was a "Santa Claus"  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_





APPENDIX C Raw Data, Class 7306

(N=20)

STUD. NO.	FLIGHT GRADES				AVE.	A	A	D
	T-34	T-28	TS-2	"B" STAGE		STATE	TRAIT	VALUE
1.	3.08	3.07	3.12	3.12	3.08	49	29	20
2.	3.04	3.00	3.04	3.05	3.02	37	31	6
3.*	3.50	3.50	3.50	3.50	3.50	50	44	6
4.	3.00	2.94	3.05	3.10	2.98	44	33	11
5.*	3.04					50	39	11
6.	3.07	3.04	3.08	3.10	3.06	47	37	10
7.	3.04	3.08	3.12	3.11	3.09	38	22	16
8.*						33	34	(1)
9.	3.00	3.05	3.09	3.10	3.05	41	29	12
10.	3.04	3.00	3.07	3.05	3.03	64	38	26
11.	3.00	2.99	3.11	3.10	3.02	59	26	33
12.	3.02	3.07	3.14	3.09	3.08	39	34	5
13.	2.99	2.98	3.02	3.03	2.99	34	24	10
14.	3.03	3.05	3.12	3.04	3.07	48	26	22
15.	3.01	3.00	3.00	3.03	3.00	46	40	6
16.*						42	36	6
17.*						71	63	8
18.*						41	33	8
19.*						39	27	12
20.*						49	30	19

\* Incompatible grading system



## APPENDIX D Raw Data, Class 7304

(N=20)

STUD. NO.	FLIGHT GRADES				AVE.	A STATE	A TRAIT	D VALUE
	T-34	T-28	TS-2	"B" STAGE				
1.	3.06	3.05	3.12	3.13	3.07	43	37	6
2.	3.06	3.03	3.08	3.08	3.05	52	30	22
3.	3.02	3.06	3.09	3.11	3.07	67	33	34
4.	3.06	3.07	3.00	3.00	3.05	75	39	36
5.	3.01	3.06	3.08	3.12	3.06	61	32	29
6.	2.99	3.03	3.09	3.08	3.03	55	40	15
7.	3.04	3.07	3.04	3.04	3.06	41	29	12
8.	3.08	3.19	3.09	3.07	3.15	52	35	17
9.	3.05	3.11	3.08	3.10	3.0	43	34	9
10.	3.12	3.12	3.17	3.15	3.13	38	35	3
11.	3.10	3.07	3.10	3.10	3.08	47	54	(7)
12.*					3.10	49	34	15
13.	3.04	3.04	3.12	3.15	3.06	41	33	8
14.	3.17	3.08	3.15	3.11	3.11	50	32	18
15.	3.02	3.01	3.10	3.10	3.03	46	35	11
16.*						62	39	43
17.	3.06	3.00	3.07	3.10	3.04	52	25	27
18.	2.98	3.08	3.07	3.09	3.07	31	36	(5)
19.	3.07	2.98	3.07	3.07	3.01	65	29	36
20.	3.10	3.13	3.15	3.16	3.13	37	29	8

\* Incompatible grading system



APPENDIX E      Raw Data, Class 7305

(N=14)

STUD. NO.	FLIGHT GRADES				AVE.	A	A	D
	T-34	T-28	TS-2	"B" STAGE		STATE	TRAIT	VALUE
1*					3.0	29	27	2
2.	3.03	3.01	3.06	3.08	3.02	43	37	6
3.	2.80	2.90	3.10	3.10	2.93	39	35	4
4.	3.05	3.03	2.99	2.98	3.02	54	28	26
5.	2.96	3.08	3.06	3.07	3.06	43	25	18
6.	3.02	3.00	3.04	3.02	3.01	31	37	(6)
7.	3.10	2.94	3.15	3.10	3.01	59	29	30
8.	3.16	3.11	3.12	3.12	3.12	28	29	(1)
9.	2.90	3.03	3.05	3.05	3.02	55	28	27
10.	3.04	3.05	3.21	3.18	3.09	40	26	14
11.	3.08	3.10	3.08	3.13	3.09	37	32	5
12.	3.04	3.18	3.20	3.30	3.16	45	32	13
13.*					2.98	44	29	15
14.	3.01	3.08	3.1	3.1	3.08	42	26	16

\* Incompatible grading system



APPENDIX F      Raw Data , Class 7307

STUD. NO.	(N=19) FLIGHT GRADES				AVE.	A STATE	A TRAIT	D VALUE
	T-34	T-28	TS-2	"B" STAGE				
1.	3.10	3.02	3.05	3.05	3.04	47	30	17
2.	3.17	3.15	3.14	3.14	3.15	24	21	3
3.	3.03	2.98	3.11	3.09	3.02	39	35	4
4.	3.04	3.05	3.13	3.12	3.07	57	26	31
5.	3.14	3.09	3.12	3.10	3.11	40	31	9
6.	3.03	3.06	3.08	3.07	3.06	41	32	9
7.	3.0	2.98	3.05	3.00	3.00	65	33	32
8.	2.98	2.98	2.98	3.0	2.98	57	40	17
9.	2.96	3.06	3.00	3.00	3.02	37	24	13
10.	3.11	3.00	2.85	2.80	2.98	22	26	(4)
11.	3.05	3.01	3.00	3.00	3.04	48	45	3
12.	3.06	3.03	3.10	3.10	3.05	31	29	2
13.	2.95	3.04	2.97	3.00	3.02	50	42	8
14.	3.10	3.07	3.07	3.00	3.07	50	28	22
15.	3.10	3.07	3.13	3.11	3.09	49	26	23
16.	3.00	3.02	3.02	3.05	3.02	55	30	25
17.	3.05	3.00	3.05	3.05	3.02	50	32	18
18.	3.21	3.02	3.09	3.10	3.06	45	35	10
19.	3.03	3.04	3.07	3.05	3.05	60	36	24





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ABSTRACT

To properly select individuals for flight training using anxiety as a predictor, it was necessary to investigate various aspects of anxiety. Initially, anxiety must be defined and its relationship to learning and task performance revealed. Additionally the effects of an instructor pilot known as a "screamer" were analyzed. Empirical data was drawn from flight students at Patrol Squadron Thirty-One using the State-Trait Anxiety Inventory and a Supplementary Questionnaire. Although no statistically significant correlations between state and trait anxiety and flight grades were revealed, the correlations were all negative as face validity would indicate. Additionally, of thirty-three students, all indicated the "screamer" as a detriment to learning and task performance to various degrees.

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